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Contents lists available at ScienceDirect

Journal of Corporate Finance

journal homepage: www.elsevier.com/locate/jcorpfin

The medium of exchange in acquisitions: Does the private information of both acquirer and target matter? ☆

Thomas J. Chemmanur^{a,*}, Imants Paeglis^b, Karen Simonyan^c

^a Department of Finance, Boston College, Chestnut Hill, MA 02467, United States

^b Department of Finance, Concordia University, Montreal, Quebec, Canada H3G 1M8

^c Department of Finance, Suffolk University, Boston, MA 02108, United States

ARTICLE INFO

Article history:

Received 24 August 2008

Received in revised form 19 August 2009

Accepted 21 August 2009

Available online 2 September 2009

JEL classification:

G34

Keywords:

Mergers and acquisitions

Medium of exchange

Asymmetric information

ABSTRACT

We present a direct test of the choice of the medium of exchange in acquisitions when both acquirers and targets possess private information about their own intrinsic values. We test three hypotheses: first, whether acquirers are more likely to choose a stock offer as their equity is more overvalued; second, whether acquirers facing a greater extent of information asymmetry in evaluating targets are more (or less) likely to use a stock versus a cash offer; and third, whether a cash offer deters competing bids. Our findings are as follows. First, acquirers choosing a stock offer are overvalued and those choosing a cash offer are correctly valued. Second, the greater the extent of acquirer overvaluation, the greater the likelihood of it using a stock offer; further, the greater the extent of information asymmetry faced by an acquirer in evaluating its target, the greater its likelihood of using a cash offer. Third, the extent of an acquirer's under- or overvaluation significantly affects the abnormal returns to its equity upon the acquisition announcement. Finally, the use of cash by an acquirer deters competing bids. We conclude that private information held by both acquirers and targets together determine the medium of exchange.

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1. Introduction

It is well known that in perfect capital markets, the medium of exchange in acquisitions is irrelevant, since the level and division of the merger-induced gains are the same regardless of whether the acquisition is paid for using cash or equity. However, over the last decades, several theoretical papers have demonstrated that the choice between cash and stock in mergers may be driven by private information held by both the acquirer and the target about their own values: see Fishman (1989), Hansen (1987), and Eckbo et al. (1990) for three examples of asymmetric information driven models of acquirers' choice of the medium of exchange.¹ The objective of this paper is to empirically analyze the choice of medium of exchange under asymmetric information and thereby shed light on the implications of some of the above models.

A number of papers in the literature have also studied the choice of the medium of exchange in acquisitions empirically: see, e.g., Travlos (1987), Franks et al. (1988), and Moeller et al. (2007). Our paper differs from this literature in two respects. First, rather than directly studying the relationship between the extent of information asymmetry characterizing the acquirer and target and the choice of medium of exchange, this literature relies on a comparison of the abnormal stock returns upon the

☆ An earlier version of this paper was circulated under the title "The choice of the medium of exchange in acquisitions: a direct test of the double-sided asymmetric information hypothesis."

* Corresponding author. Tel.: +1 617 552 3980; fax: +1 617 552 0431.

E-mail addresses: chemmanu@bc.edu (T.J. Chemmanur), ipaeglis@jmsb.concordia.ca (I. Paeglis), ksimonya@suffolk.edu (K. Simonyan).

¹ For other frequently mentioned factors influencing the medium of exchange, such as taxes and corporate control reasons, see Brown and Ryngaert (1991), Amihud et al. (1990), and Martin (1996).

announcement of acquisitions using cash or stock to draw indirect inferences about the effect of information asymmetry on the choice of the medium of exchange. Perhaps the absence of direct tests of asymmetric information models is not surprising, given the difficulty inherent in directly measuring the extent of information asymmetry, especially on the part of an acquirer about its own value. Second, this literature focuses on separately analyzing how private information on the part of either the acquirer or the target affects the choice of the medium of exchange, but not on how the interaction between the two affects the above choice. In contrast to this literature, in this paper we develop a methodology that allows us to conduct the first direct test of the above choice in a setting where the private information held by the acquirer and the target together determine this choice.

We now briefly discuss how the private information held by the acquirer and target may together determine the medium of exchange. Consider an acquirer choosing between a cash and a stock offer to acquire a target. Insiders of both firms have private information about their own firm values. The profitability of the acquisition to the acquirer depends not only upon the true value of the target, but also those of the acquirer and of any synergies between the two. A crucial difference here between a cash and a stock offer is that, while the value of a stock offer depends on the cash flows of the combined firm (which, in turn, depends on the true values of the acquirer, the target, and any synergies between the two), the value of a cash offer is independent of these variables. Therefore, the target may view an acquirer making a stock offer as being potentially overvalued (and may reject this offer), since such an acquirer has an incentive to make a stock offer to take advantage of its overvaluation (while an undervalued acquirer has an incentive to make a cash offer).² However, since the target itself has private information about its own value, acquirers making cash offers are in danger of overpaying for the target. The expected overpayment cost is greater when the level of information asymmetry the acquirer faces in evaluating the target is greater. In contrast, the true value of a stock offer is contingent on the cash flows of the combined firm, so that the acquirer can share the risk of the target's overvaluation with its owners. Thus, the medium of exchange in this setting is driven by the trade-off between the overpayment cost (lower in a stock offer) and the probability that the bid will be unsuccessful (higher in a stock offer).

To the above setting, let us now add the possibility that there may be more than one potential acquirer (bidder) for a given target, and that once an initial bidder identifies a target, rival bidders have to incur a cost to value their own gains from acquiring that target before they can present a competing bid. Clearly, potential rival bidders will incur this cost only if they believe that the initial bidder's private valuation of the target is not too high, since, otherwise, these rival bidders have only a low probability of succeeding in their bid. In this context, a cash offer signals to potential rival bidders that the initial bidder's private valuation of the target is high, thus deterring competition from them. Thus, in addition to increasing the probability of the bid being successful, here a cash offer has the advantage of deterring competition; this advantage is greater when the level of information asymmetry that potential rival bidders face in evaluating the target is greater.³ Recall, however, that a cash offer has the disadvantage of raising the cost of overpayment for the target. Based on the above trade-offs in this revised setting, a cash offer is more likely when the extent of information asymmetry facing acquirers in evaluating the target is greater.

The above economic arguments yield the following predictions, which we test in our empirical analysis. First, acquirers that are overvalued by the equity market (relative to their intrinsic value conditional on insiders' private information) will use stock offers and those that are undervalued will use cash offers (H1). Second, if acquirers' choice of medium of exchange is driven primarily by their difficulty in evaluating a target, then acquirers facing a greater extent of information asymmetry when evaluating the target are more likely to use stock rather than cash (H2A). If, however, considerations related to the acquirer signaling a high private valuation to other potential bidders dominate, then the greater the extent of information asymmetry faced by the acquirer about the target, the higher the likelihood of a cash offer (H2B). Finally, the above arguments imply that cash offers are less likely to face competing bids, *ceteris paribus* (H3).⁴

The methodology we adopt to establish acquirer under- or overvaluation (discussed in detail in Section 2) consists of using various valuation models to evaluate the intrinsic value of the acquirer and comparing it to its market value at the time of acquisition announcement. Further, we use various standard proxies of information asymmetry to measure the extent of asymmetric information facing the acquirer in evaluating the target. Making use of the above methodology, we conduct the following empirical tests. First, we perform univariate tests to see if cash acquirers are undervalued and stock acquirers are overvalued, and if targets taken over with stock are characterized by a higher or lower level of information asymmetry than cash targets. Second, we test whether the extent of acquirer under- or overvaluation (conditional on insiders' private information) and the level of information asymmetry facing the acquirer when evaluating the target *simultaneously* influence the acquirer's choice of the medium of exchange. Third, we study whether the extent of acquirer under- or overvaluation relative to its intrinsic value

² A well-known example of an overvalued acquirer using stock as a medium of exchange is the merger of AOL and Time Warner. This all-stock deal, announced in January 2000, gave AOL and Time Warner shareholders 55 and 45% stakes in the newly formed company, respectively. With AOL's pre-merger market value of around \$160 billion, roughly twice that of Time Warner, the combined entity's equity value was almost \$250 billion. However, by November 2000 AOL's stock price fell by almost a third from the pre-merger value of \$74 to \$47, indicating that AOL's shares were considerably overvalued at the time of the acquisition announcement. See Barth and Stockton (2000) for details.

³ In August of 1997, British Telecom (BT) revised its original \$24 billion cash and stock offer for MCI down to \$21 billion (the proportion of cash was around 20%). BT's offer put MCI "in play" and two months later WorldCom (apparently sensing that BT's private valuation of MCI was not high) made a competing \$30 billion stock bid. Two weeks later GTE made another competing \$28 billion cash bid for MCI. WorldCom finally won the bid by raising its offer to \$39 billion. Had BT originally made an all cash bid with a high enough premium, it could have potentially deterred competing bids. See Cohen and Healy (2000) for details.

⁴ The discussion of our economic setting above is related to the takeover models of Hansen (1987) and Fishman (1989), and the equity issue model of Myers and Majluf (1984). Hypothesis H1 is consistent with the predictions of all three of these models. Since Hansen (1987) does not incorporate the possibility of an acquirer signaling to other potential bidders using a cash offer, hypothesis H2A is consistent with the predictions of that model alone. Since Fishman (1989) allows for such signaling by an acquirer using a cash offer and pre-empting rival bids, hypotheses H2B and H3 are consistent with his predictions.

explains the stock returns upon the acquisition announcement (as would be expected in an asymmetric information setting). Finally, we test whether the use of cash by an acquirer signals its high valuation of the target firm to other potential bidders and therefore deters competing bids.

Our findings can be summarized as follows. First, we find from our univariate tests that acquirers choosing stock as the medium of exchange are overvalued and those choosing cash are correctly valued. These results are robust to alternative valuation models used to estimate the intrinsic value of acquirers' shares. Second, our logit and ordered logit regression analyses indicate that the greater the extent of acquirer overvaluation, the greater the likelihood of it using stock as the medium of exchange. These results are consistent with H1, and thereby lend support to the predictions of the asymmetric information models discussed above. Further, the greater the extent of information asymmetry faced by an acquirer in evaluating a target, the greater the likelihood that it uses cash as the medium of exchange. This finding is consistent with H2B: i.e., it is consistent with considerations of the acquirer signaling its high private valuation of the target to rival bidders dominating those of its difficulty in evaluating the target. Third, the extent of acquirer overvaluation is negatively related to the abnormal returns to the acquirer's equity upon the acquisition announcement. Finally, we find that the use of cash by an acquirer deters rival bids, supporting H3, and thus consistent with the notion that the use of cash may signal the acquirer's high valuation of the target to potential rivals.⁵ Ours is the first paper to demonstrate that private information on the part of acquirer and target simultaneously determines the choice between cash and stock. Most of the other empirical findings we list above are also new to the literature.

Our findings are related to several strands in the literature. In a recent paper, Officer et al. (2009) find that acquirers obtain higher announcement returns when using stock to acquire targets that are difficult to value (especially private targets). They interpret this finding as consistent with the notion that the use of stock as a method of payment helps a publicly traded acquirer share the risk of a target's overvaluation with the target's owners. It is worth noting that the focus of their study is primarily on privately held targets, which (as they point out) are much less likely to elicit competing bids. Since our study focuses exclusively on acquisitions of publicly traded targets, it is not surprising that considerations of signaling to other potential bidders dominate in our setting, resulting in our finding that targets characterized by a greater extent of information asymmetry are more likely to be acquired by cash rather than stock.

Another related paper is Moeller et al. (2007), who find that the abnormal returns to acquirers of public firms paid for with equity are negatively related to the extent of information asymmetry characterizing the acquirer. Similarly Travlos (1987) finds significantly negative returns for acquirers in stock mergers and insignificantly positive returns in cash mergers and tender offers. Finally, Houston and Ryngaert (1997) study conditional stock offers in bank mergers and find that the abnormal returns to the bidder are greater when a greater proportion of cash is used to pay for the target. While, unlike our paper, the above three papers do not directly study the relationship between the extent of overvaluation of an acquirer and abnormal stock returns to that acquirer, our results are consistent with theirs to the extent that our paper also documents negative announcement stock returns to acquirers in equity-financed acquisitions, thus joining them in providing support for the implications of asymmetric information models such as Myers and Majluf (1984), Hansen (1987), and Fishman (1989).^{6,7,8}

The rest of the paper is organized as follows. Section 2 discusses our empirical methodology. Section 3 describes our data. Our empirical tests and their results are presented in Section 4. Section 5 concludes with a summary of our results.

2. Empirical methodology

2.1. Overall methodology

The methodology we adopt can be summarized as follows. In the economic setting we study, the acquirer moves first and makes a bid for the target, based on private information about its own value, keeping in mind that the target has private information about its own value and may accept or reject the bid based on that private information. Therefore, to test our hypotheses, we need to measure two variables for each acquisition, one related to the value of the acquirer and the other related to the value of the target. Given that an important determinant of the acquirer's choice of medium of exchange is its private information about its own value, the first variable should incorporate the effects of this private information, namely, the under- or overvaluation of the acquirer in the stock market relative to its intrinsic value (conditional on insiders' private information). We approach this measurement problem assuming rational expectations on the part of acquiring firm insiders. Under rational

⁵ Our findings are in contrast to those of Jennings and Mazzeo (1993) who find that the use of cash is *positively* associated with the likelihood of competition. While Jennings and Mazzeo (1993) study only the extent of information asymmetry facing the acquirer about the target, we demonstrate that, once we account for the private information held by both acquirer and target, the use of cash indeed deters competing bids.

⁶ See also related studies by Fuller et al. (2002) and Moeller et al. (2005) on acquirer announcement effects, and Officer (2004) and Faccio and Masulis (2005) on the choice of medium of exchange. Two other studies distantly related to this paper are Officer (2003) and Betton and Eckbo (2000), who study the influence of termination fees and toeholds, respectively, on acquisitions.

⁷ Dong et al. (2006) study the relationship between misvaluation based on public information at the time of takeover announcements and various aspects of the takeover market. The focus of our paper, however, is on firm-level asymmetric information and its influence on the choice of the medium of exchange. In particular, we show that the private-information-based valuation errors are higher than those based on the publicly available information at the time of the takeover announcement. See also Chang (1999), who studies the valuation of bidders and targets around acquisition announcements.

⁸ The evidence on post-acquisition operating performance of acquirers is inconclusive. Healy et al. (1992) and Heron and Lie (2002) find an improvement in such performance in general, but no difference between cash and stock acquirers. Linn and Switzer (2001) find an improvement in the operating performance of cash acquirers, but no improvement in the performance of stock acquirers.

expectations, there should be no systematic bias in firm insiders' prediction of their firm's future earnings stream. This allows us to use the realized values of the post-acquisition earnings of the acquirer to estimate the intrinsic value of its shares conditional on insiders' private information. We estimate these intrinsic values using two models: the residual income (RIM) model and the Ohlson (2005) model (OHL).⁹ Once the acquirer's intrinsic value conditional on insiders' private information has been established, we can directly measure the extent of acquirer under- or overvaluation by comparing this intrinsic value with the market value at the time of the acquisition, and relate it to the choice of the medium of exchange.

The second variable we need to test our hypotheses is the extent of information asymmetry faced by the acquirer in evaluating the target. Assuming that, when evaluating the target, the information asymmetry facing the acquirer is correlated with that facing other outside investors in the market, we use standard proxies to measure the extent of information asymmetry facing the acquirer when evaluating the target: the number of analysts following the target, the standard deviation of analyst forecasts about the target, and the analyst forecast error about the target.¹⁰

Finally, given that the acquisition will be consummated only if the target accepts the acquirer's bid, and that the target's willingness to accept the bid in the case of an equity offer depends upon the extent of information asymmetry it faces when evaluating the acquirer's stock (even after observing the acquirer's choice of the medium of exchange), we also control for the extent of this information asymmetry in our empirical tests. Since the information asymmetry faced by the target will be correlated with that of other outsiders in the stock market, we use standard proxies to measure the extent of information asymmetry faced by the target in evaluating the acquirer: the number of analysts following the acquirer, the standard deviation of analyst forecasts about the acquirer, and the analyst forecast error about the acquirer.

2.2. Measurement of acquirer under- or overvaluation

We now describe the valuation models used to estimate the intrinsic value of the acquirer's shares and the methodology used to measure the extent of under- or overvaluation of the acquirer in the equity market relative to its intrinsic value. To estimate this intrinsic value, we make use of the realized values of the acquirer's earnings in the years subsequent to the acquisition. If firm insiders (managers) have private information about the firm's future cash flows at the time of the acquisition, and have rational expectations (so that there is no systematic bias in their prediction of their firm's future earnings stream), the above intrinsic value will yield us an unbiased estimate of the insiders' valuation of the acquirer conditional on their private information at the time of the acquisition.¹¹ After estimating this intrinsic value, we will calculate the extent of acquirer under- or overvaluation in the stock market at the time of the acquisition (as discussed in Section 2.2.3).

To account for the possibility that any particular model might systematically overvalue one set of firms and undervalue another, we use two different valuation models to compute intrinsic value: (1) the residual income model (RIM); and (2) the Ohlson (2005) model (OHL).¹²

2.2.1. The residual income model

We implement the residual income model (see Ohlson, 1990) following the set-up used by D'Mello and Shroff (2000) and Jindra (2000):

$$V_0 = B_0 + \frac{EPS_1 - r \times B_0}{1 + r} + \frac{EPS_2 - r \times B_1}{(1 + r)^2} + TV, \quad (1)$$

where B_0 is the book value of equity at the end of the fiscal year in which the acquisition was announced (Compustat item 60) divided by the number of shares outstanding (Compustat item 25); EPS is the income before extraordinary items (Compustat item 237) divided by the number of shares outstanding; and r is the required rate of return on the acquirer's equity. According to Eq. (1), firm value is determined as the sum of its book value and discounted future earnings in excess of a normal return on book value (known as residual income or abnormal earnings). Thus, firm value depends on the stock variable (book value) and the flow variables that relate to the wealth to be generated by the firm in the future (see, e.g., D'Mello and Shroff, 2000). We use two measures of r : (1) a constant (across firms) required rate of return of 13%; and (2) a firm-specific rate of return, obtained from the

⁹ We chose these earnings-based valuation models due to the ease of implementation. Other possible models include capital cash flow and dividend discount models (see, e.g., Kaplan and Ruback, 1995). Penman (1998), however, shows that, if implemented correctly, the three approaches (residual income, capital cash flow, and dividend discount models) should yield identical estimates.

¹⁰ It can be argued that acquirers may have more information obtained through confidentiality agreements and discussions with the target management. However, even if an acquirer has more information about a target than other investors in the market, the information asymmetry facing the acquirer in the equity market (though less) is most likely correlated with that facing other investors. So the greater the extent of information asymmetry about the target in the equity market in general, the greater the extent of information asymmetry faced by the acquirer when evaluating the target.

¹¹ Note that our assumption is *not* that acquirer firm insiders can perfectly forecast the future earnings of their firm, but rather that they can make better forecasts than outsiders, and that their forecasts will not be systematically biased upwards or downwards.

¹² In addition to the above two models, we also implemented a price-earnings ratio based valuation model to estimate the intrinsic value of acquirer's shares (see, among others, Kaplan and Ruback, 1995; Kim and Ritter, 1999). Using this model we obtained the intrinsic value of the acquirer's equity by multiplying the next fiscal year's realized value of the acquirer's earnings by the industry median price-earnings ratio at the end of the fiscal year prior to the acquisition announcement. Due to space limitations we do not report our results using this valuation model; however these results were similar to those reported in this paper.

market model with beta calculated over 250 trading days ending on the 46th trading day before the acquisition announcement. In the calculation of beta, we require at least 100 observations. The risk-free rate is the annualized one-month T-bill rate in the month preceding the acquisition announcement, while the market risk premium is the annualized average difference between the rate of return on the CRSP value-weighted index and the one-month T-bill rate between January 1945 and the month preceding the acquisition announcement.¹³ In the rest of the paper, RIMC and RIMF refer to the residual income model implemented using a constant (13%) and a firm-specific discount rate derived from the market model, respectively.

The terminal value, TV, is calculated as follows:

$$TV = \frac{(EPS_2 - r \times B_1) + (EPS_3 - r \times B_2)}{2 \times (1 + r)^2 \times r} \quad (2)$$

To avoid the effect of a possible unusual performance in year 3, the terminal value is calculated as an average of residual earnings in years 2 and 3. If the terminal value is negative, we set it equal to zero because managers are unlikely to continue negative NPV investments forever. Also, in implementing this model, we exclude firms with negative book values of equity and those with negative estimated fair values of shares.¹⁴

The realized values of post-acquisition earnings are the sum of the earnings of the acquirer and the target, plus the value of any synergy generated by the acquisition. In order to obtain the stand-alone acquirer's earnings, we use the target's average income before extraordinary items (calculated over the 4 years preceding the acquisition) as a proxy for the target's earnings.¹⁵ In all the following results we exclude acquirers whose targets had negative average earnings. We do so for two reasons. First, negative target earnings are unlikely to continue after the acquisition. Second, inclusion of acquirers whose targets had negative earnings before the acquisition would induce an upward bias in our estimate of the intrinsic value of stand-alone acquirers.¹⁶ We also make the following adjustments to the earnings, book value of equity, and the number of shares outstanding in the joint firm. For acquisitions that used the pooling of interest method of accounting, we subtract the book value of target's equity from the book value of the joint firm and the number of shares issued to the target's shareholders from the number of shares outstanding in the joint firm. We also subtract the target's earnings from those of the joint firm. For acquisitions that used the purchase method of accounting we make the following adjustments. For both stock and cash acquisitions in the fiscal year when the merger was completed we subtract a fraction of target's earnings (proportional to the time between the merger completion date and the end of the fiscal year) from the earnings of the joint firm, while for the subsequent years we subtract the full amount of target's earnings. For stock acquisitions, we also subtract the amount paid for the target from the book value of equity of the joint firm and the number of shares issued to the target's shareholders from the number of shares outstanding in the joint firm.¹⁷

2.2.2. The Ohlson (2005) model

Our second valuation model is an alternative to the residual income model suggested by Ohlson (2005). This model uses the earnings per share (adjusted for dividends per share) as the starting point in the calculation of the intrinsic value. We implement the model as follows:

$$V_0 = \frac{EPS_0}{r} + \frac{\frac{EPS_1}{r} - [(1 + r) \times \frac{EPS_0}{r} - DPS_1]}{1 + r} + \frac{\frac{EPS_2}{r} - [(1 + r) \times \frac{EPS_1}{r} - DPS_2]}{(1 + r)^2} + TV, \quad (3)$$

where EPS is the earnings per share; DPS is the dividends per share (Compustat item 21 divided by Compustat item 25); r is the required rate of return on the acquirer's equity, and

$$TV = \frac{\left(\frac{EPS_2}{r} - [(1 + r) \times \frac{EPS_1}{r} - DPS_2]\right) + \left(\frac{EPS_3}{r} - [(1 + r) \times \frac{EPS_2}{r} - DPS_3]\right)}{2 \times (1 + r)^2 \times r} \quad (4)$$

We exclude firms that had negative EPS in any of the 4 years used in the estimation. As in the case of the residual income model, if the estimated terminal value is negative, we set TV above equal to zero. We implement this model using both a constant (13%)

¹³ We also used a firm-specific discount rate calculated using a constant (across observations) market risk premium of 8%. Our results are qualitatively unchanged in this alternative specification.

¹⁴ We also implement the residual income model by calculating the terminal value, TV, assuming a 2% and a 5% perpetual growth in earnings after year 3, respectively. The results of our analysis using growth in earnings in this valuation model were similar to those reported in this paper.

¹⁵ We also replicated the estimation using the target's earnings in the last fiscal year prior to acquisition as a proxy for target's earnings; the results were qualitatively unchanged.

¹⁶ The consequence of this exclusion, however, is a reduced sample size. To see if this exclusion induced any selection bias, we replicated all of the subsequent results using the valuation errors estimated using earnings of combined firms (rather than stand-alone acquirers). The results were qualitatively unchanged. This leads us to believe that while the imposition of such a requirement reduces our sample size, it does not lead to a significant selection bias.

¹⁷ In the adjustments described above we subtract only the target's earnings from the earnings of the joint firm, leaving the acquirer's earnings and the earnings due to the synergy generated by the merger. This introduces a possible bias in our results for cash acquirers, which we expect to be undervalued. For stock acquirers, however, inclusion of the synergy will bias the results against us: if the firm is overvalued with synergy, it will be even more overvalued without it.

and a firm-specific discount rate. In the rest of the paper, OHLC and OHLF refer to the Ohlson (2005) model, implemented using a constant and a firm-specific discount rate, respectively.¹⁸

2.2.3. Measurement of acquirer under- or overvaluation

Acquirer under- or overvaluation is measured using a “valuation error,” VE, defined as:

$$VE = \ln(P_0 / V_0), \quad (5)$$

where P_0 is the acquirer's closing share price on the day before the acquisition announcement and V_0 is the intrinsic value of the acquirer's shares conditional on insiders' private information at the time of the acquisition (to be estimated using the methodology above).¹⁹ We choose to measure the under- or overvaluation of the acquirer's stock on the day before the acquisition announcement, since the acquirer chooses the medium of exchange after observing its stock price as of this day.²⁰

To account for a possible bias inherent in valuation models used to calculate the intrinsic value of acquirer's shares, we compare acquirer valuation errors (VE_A) with those of a sample of industry-and-size-matched firms (VE_M).²¹ If VE_A is less than VE_M , the acquirer is undervalued; if VE_A is greater than VE_M , the acquirer is overvalued. The matched firms are found as follows. First, we match by the 3-digit SIC code and then by the market value of equity at the end of the fiscal year preceding the acquisition announcement. Second, when finding a matching firm for an acquirer in a particular year, we exclude all firms that made acquisitions during that year.²²

2.3. Proxies for asymmetric information

We use the following proxies to measure the extent of information asymmetry faced by the acquirer in evaluating the target. We use the standard proxies in the literature for information asymmetry facing investors in the equity market about a firm. The first such measure is the number of analysts following the target (NUMA).²³ We use the number of analysts (and the following two proxies) as reported by IBES for the last month of the fiscal year preceding the acquisition announcement. The greater the number of analysts, the lower the extent of information asymmetry. Our second measure is the standard deviation of analyst forecasts (STDFOR). A larger standard deviation implies less agreement between analysts and, consequently, a higher level of information asymmetry. The third measure we use is the analyst forecast error (FORERR), defined as the absolute value of the difference between the analyst earnings forecast reported by IBES and the realized value of the earnings, divided by the stock price. A larger forecast error indicates a higher level of information asymmetry.

We also use a fourth measure which may capture any special ability the acquirer has in evaluating the target due to its industry expertise (which may reduce the degree of the asymmetric information that the acquirer faces in evaluating the target, compared to that faced by other outside investors in the equity market). This is a measure of the degree of relatedness between the target and acquirer (REL), which takes on a value of one if the target and acquirer have the same 3-digit SIC code (obtained from Compustat), and zero otherwise. The more related the acquirer and the target, the less the information asymmetry facing the acquirer in evaluating the target.

Since, as discussed above, the target's decision to accept a stock offer (and the likelihood of that offer succeeding) depends upon the extent of information asymmetry it faces when evaluating the acquirer, we control for the extent of this information asymmetry using proxies similar to those described above: the number of analysts following the acquirer (ANUMA), the standard deviation of analyst forecasts about the acquirer (ASTDFOR), and the analyst forecast error about the acquirer (AFORERR). These variables are calculated as described previously for the targets and are for the last month of the fiscal year preceding the acquisition announcement.

3. Sample selection and data

We study successful takeovers that were announced between 1978 and 2004. The list of acquirers and targets (as well as various deal characteristics) comes from the SDC Mergers and Acquisitions database, subject to the following selection criteria. First, we require acquirer and target to be publicly traded U.S. corporations with accounting data available on Compustat. Second,

¹⁸ We also implement the Ohlson (2005) model by calculating the terminal value, TV, assuming a 2% and a 5% perpetual growth in earnings after year 3, respectively. The results of our analysis using growth in earnings in this valuation model were similar to those reported in this paper.

¹⁹ Notice that the use of alternative measures such as the percentage difference between acquirer's stock price and its intrinsic value would allow for the extent of acquirer overvaluation to be unbounded, while the extent of undervaluation would be limited to negative 100%. To avoid this asymmetry, we choose to use the log differences. However, our results are qualitatively unchanged if we use percentage differences instead.

²⁰ We have replicated our empirical analysis using the acquirer's stock price as of the effective date of the acquisition. Our results are qualitatively unchanged using this alternative measure of overvaluation.

²¹ Ritter and Warr (2001), Chang et al. (1999), Lee et al. (1999), D'Mello and Shroff (2000), and Jindra (2000) show that the residual income model tends to consistently undervalue stocks (i.e., that there is a positive VE).

²² The comparison of acquirer valuation errors with those of industry-and-size-matched firms in the same year also allows us to differentiate between aggregate stock market misvaluation and the misvaluation due to firm-level information asymmetry. Our findings of significant differences between acquirer valuation errors and those of matched firms indicate that firm-level information asymmetry is an important factor driving the choice of the medium of exchange.

²³ This and the next two proxies have been used by, among others, Krishnaswami and Subramaniam (1999) and Thomas (2002) to measure the level of information asymmetry about a firm in the equity market.

Table 1

Number of acquisitions by calendar year and the medium of exchange, 1978–2004.

Year	All	Cash	Stock	Mixed
1978	8	4	4	0
1979	3	2	1	0
1980	5	5	0	0
1981	5	4	1	0
1982	0	0	0	0
1983	0	0	0	0
1984	10	5	4	1
1985	39	20	14	5
1986	49	41	5	3
1987	35	21	12	2
1988	44	33	10	1
1989	25	14	8	3
1990	21	10	10	1
1991	15	2	9	4
1992	12	3	6	3
1993	20	7	10	3
1994	49	17	28	4
1995	60	14	41	5
1996	63	18	41	4
1997	69	20	44	5
1998	89	27	54	8
1999	70	29	36	5
2000	38	18	17	3
2001	29	10	15	4
2002	18	11	5	2
2003	17	6	5	6
2004	24	11	7	6
Total	817	352	387	78

we require that the acquirer holds less than 50% of the target's equity before and 100% of the target's equity after the acquisition. Third, we exclude all financial firms (i.e., firms with SIC codes between 6000 and 6999). Finally, we exclude all acquisitions where the medium of exchange was not cash, stock, or a combination thereof. Our final sample includes 817 acquisitions; this is our main sample for which we have sufficient accounting data to calculate acquirer intrinsic values using the residual income model with a firm-specific discount rate. Table 1 shows the distribution of the sample across the years and the medium of exchange and indicates that 43% of acquisitions in our sample are for cash, 47% are for stock, and the remaining 10% are for a combination of cash and stock.

Accounting data comes from Compustat; stock price and return data comes from CRSP. The data necessary to calculate asymmetric information measures comes from IBES. The sample size varies for various tests and valuation models due to the availability of necessary data items.²⁴

4. Empirical tests and results

In this section we test the hypotheses presented earlier. First, we discuss the summary statistics and conduct univariate tests to determine if there are any differences in the valuation errors and information asymmetry (both on the acquirer and on the target side) between firms that chose cash and those that chose stock as the medium of exchange. Second, we run logit and ordered logit regressions to test whether our proxies for information asymmetry simultaneously influence the choice between cash and stock. Third, we study the relationship between valuation errors and the abnormal returns to the acquirer's equity upon the acquisition announcement. Finally, we directly test whether cash bids indeed deter competing bids.

4.1. Univariate tests

4.1.1. Summary statistics

Panel A of Table 2 presents the summary statistics for our sample. The means and medians of valuation errors are positive, which indicates that our valuation models undervalued acquirers (see footnote 21). We will determine the true under- or overvaluation of acquirers by comparing their valuation errors to those of matched firms in Table 3. In 56% of acquisitions both acquirer and target belonged to the same 3-digit SIC code industry. The extent of information asymmetry about targets is greater

²⁴ While we are able to use the full sample of 817 firms in our acquirer valuation tests using the residual income model, the sample size drops to 509 firms when using the Ohlson (2005) model, which requires additional accounting data. Even when using the residual income model, our sample size drops to around 600 firms in the tests involving the asymmetric information proxies about the target (depending on a proxy used), since analyst forecast data is available only for a smaller number of firms. See Panel A of Table 2 for details.

Table 2
Summary statistics.

Panel A. Summary statistics for the entire sample of acquisitions.							
	N	mean	median	min	max	sd	
VERIMC	817	0.94	0.86	−1.75	5.94	0.85	
VERIMF	817	0.89	0.80	−4.05	6.86	0.99	
VEOHLC	504	0.66	0.63	−2.41	6.98	1.12	
VEOHLF	509	0.50	0.56	−5.15	6.19	1.34	
REL	817	0.56	1.00	0.00	1.00	0.50	
FORERR	606	0.02	0.00	0.00	2.23	0.10	
STDFOR	558	0.07	0.03	0.00	1.01	0.11	
NUMA	651	6.91	5.00	1.00	38.00	6.47	
AFORERR	737	0.01	0.00	0.00	0.24	0.02	
ASTDFOR	711	0.07	0.02	0.00	5.29	0.27	
ANUMA	743	13.71	12.00	1.00	47.00	9.41	
CD	816	0.77	0.25	0.00	35.40	2.23	
RSIZE	811	0.32	0.13	0.00	6.11	0.55	
SIZE	811	1.03	0.13	0.00	61.77	4.74	
MB	767	2.71	1.99	−10.44	40.45	2.91	
ASIZE	817	9.56	1.31	0.00	422.64	30.05	
AMB	803	4.13	2.72	−40.29	297.23	11.10	
COMPETE	817	0.07	0.00	0.00	1.00	0.26	
BPREM	775	46.21	40.74	−50.82	561.76	40.03	
ANEFOT5	817	−0.01	−0.01	−0.38	0.43	0.08	
ANEF_1TO1	817	−0.01	−0.01	−0.35	0.51	0.07	
ANEF0	815	−0.01	0.00	−0.25	0.41	0.05	

Panel B. Summary statistics and univariate tests of the differences in means and medians for the acquisitions where the medium of exchange was either cash or stock.

	Cash						Stock						Difference in means	Difference in medians
	N	mean	median	min	max	sd	N	mean	median	min	max	sd		
VERIMC	352	0.72	0.68	-1.75	5.49	0.71	387	1.19	1.05	-0.95	5.94	0.92	-0.47 (-7.69)***	-0.36 (-7.78)***
VERIMF	352	0.65	0.60	-2.53	6.40	0.78	387	1.16	1.05	-4.05	6.86	1.10	-0.51 (-7.14)***	-0.45 (-8.07)***
VEOHLC	238	0.58	0.58	-2.17	3.86	1.02	220	0.81	0.71	-2.41	6.98	1.21	-0.23 (-2.22)**	-0.13 (-1.74)*
VEOHLF	241	0.41	0.48	-5.15	4.22	1.12	221	0.71	0.75	-5.03	6.19	1.47	-0.30 (-2.47)**	-0.28 (-2.75)**
REL	352	0.47	0.00	0.00	1.00	0.50	387	0.62	1.00	0.00	1.00	0.49	-0.15 (-4.09)***	-1.00 (-4.05)***
FORERR	239	0.03	0.00	0.00	2.23	0.15	308	0.01	0.00	0.00	0.32	0.03	0.02 (2.18)**	0.00 (4.32)***
STDFOR	215	0.08	0.04	0.00	0.81	0.11	291	0.05	0.02	0.00	0.67	0.08	0.03 (3.87)***	0.02 (4.15)***
NUMA	260	5.96	4.00	1.00	32.00	5.62	328	7.50	5.00	1.00	38.00	6.78	-1.54 (-2.94)***	-1.00 (-2.99)***
AFORERR	316	0.01	0.00	0.00	0.24	0.02	356	0.00	0.00	0.00	0.18	0.01	0.00 (2.02)**	0.00 (3.25)***
ASTDFOR	303	0.08	0.02	0.00	5.29	0.33	347	0.05	0.02	0.00	1.65	0.12	0.04 (2.24)**	0.00 (2.41)**
ANUMA	317	14.06	12.00	1.00	42.00	9.36	361	13.62	12.00	1.00	40.00	9.18	0.44 (0.62)	0.00 (0.69)
CD	352	1.21	0.44	0.00	35.40	3.10	386	0.46	0.18	0.00	20.75	1.18	0.75 (4.39)***	0.25 (6.90)***
RSIZE	347	0.25	0.07	0.00	4.03	0.52	386	0.34	0.18	0.00	6.11	0.53	-0.09 (-2.23)**	-0.10 (-6.30)***
SIZE	347	0.31	0.09	0.00	7.05	0.71	386	1.57	0.20	0.00	61.77	6.54	-1.26 (-3.58)***	-0.11 (-5.91)***
MB	316	2.17	1.63	-10.44	19.65	2.50	377	3.26	2.38	0.51	40.45	3.26	-1.09 (-4.88)***	-0.75 (-7.05)***
ASIZE	352	10.15	1.56	0.01	208.44	29.24	387	9.52	1.31	0.00	422.64	32.83	0.63 (0.27)	0.26 (0.16)
AMB	344	3.83	2.27	-40.29	297.23	16.27	382	4.49	3.28	0.58	50.80	4.26	-0.66 (-0.76)	-1.01 (-6.77)***
COMPETE	352	0.12	0.00	0.00	1.00	0.32	387	0.03	0.00	0.00	1.00	0.16	0.09 (5.04)***	0.00 (4.96)***
BPREM	332	51.24	45.49	-31.58	236.84	37.75	370	40.96	36.13	-41.86	169.90	32.55	10.28 (3.87)***	9.36 (3.72)***
ANEFOTO5	352	0.01	0.01	-0.12	0.41	0.06	387	-0.03	-0.02	-0.38	0.43	0.09	0.04 (6.72)***	0.03 (7.09)***
ANEF_1TO1	352	0.01	0.00	-0.13	0.51	0.06	387	-0.02	-0.02	-0.35	0.27	0.08	0.03 (6.48)***	0.02 (6.95)***
ANEF0	350	0.00	0.00	-0.14	0.41	0.04	387	-0.01	-0.01	-0.25	0.19	0.06	0.02 (5.05)***	0.01 (5.05)***

VERIMC and VERIMF refer to the acquirer valuation errors estimated using the residual income model with a constant discount rate of 13% and a firm-specific discount rate, respectively. VEOHLC and VEOHLF refer to the acquirer valuation errors estimated using the Ohlson (2005) model with a constant discount rate of 13% and a firm-specific discount rate, respectively. Valuation error is the log of the ratio of the acquirer's closing price on the day before the acquisition announcement to the intrinsic value of the acquirer's shares estimated using a particular valuation model. REL is equal to one if the acquirer and the target have the same 3-digit SIC code, and zero otherwise. FORERR and AFORERR are the target's and the acquirer's analyst forecast errors defined as the ratio of the absolute value of the difference between the analyst forecast and the realized value of earnings to the stock price, respectively. STDFOR and ASTDFOR are the standard deviations of target's and acquirer's earnings forecasts as reported by IBES for the last month of the fiscal year preceding the acquisition announcement, respectively, while NUMA and ANUMA are the numbers of analysts following the target and the acquirer in the same month, respectively. CD is the ratio of the acquirer's holdings of cash and marketable securities at the end of the fiscal year preceding the acquisition announcement to the amount paid for the target. RSIZE is the ratio of the market value of target's equity to the market value of acquirer's equity. SIZE and ASIZE are the target's and the acquirer's market values of equity at the end of the fiscal year preceding the acquisition announcement (in \$billions), respectively. MB and AMB are the target's and the acquirer's market-to-book ratios at the end of the fiscal year preceding the acquisition announcement, respectively. COMPETE is equal to one if there was a competing offer for the target, and zero otherwise. BPREM is the initial bid premium, defined as the percentage by which the initial bid exceeds the target's closing share price 4 weeks before the acquisition announcement. ANEFOTO5 and ANEF_1TO1 are the abnormal returns to acquirer's equity upon the acquisition announcement over windows of 0 to +5 days and -1 to +1 days, respectively, where day 0 is the acquisition announcement date. ANEF0 is the abnormal return to acquirer's equity on the day of acquisition announcement. The results of t-tests for the difference in means and non-parametric Wilcoxon rank-sum tests for the difference in medians are reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively.

Table 3

Univariate tests of the acquirer-side asymmetric information hypothesis.

	N	Acquirer valuation errors					Matched firm valuation errors					Difference in means	Difference in medians
		mean	median	min	max	sd	mean	median	min	max	sd		
<i>Stock</i>													
VERIMC	373	1.150	1.047	-0.482	3.674	0.769	0.923	0.771	-1.866	4.060	0.828	0.227 (4.95)***	0.276 (5.34)***
VERIMF	370	1.121	1.033	-1.125	3.650	0.872	0.810	0.684	-3.019	4.551	0.976	0.312 (5.92)***	0.350 (6.05)***
VEOHLC	188	0.740	0.699	-1.762	3.844	0.953	0.605	0.474	-2.206	5.095	1.053	0.135 (1.41)	0.224 (1.74)*
VEOHLF	186	0.676	0.746	-3.368	3.968	1.217	0.537	0.417	-2.998	5.498	1.307	0.139 (1.23)	0.329 (1.76)*
<i>Cash</i>													
VERIMC	340	0.718	0.684	-0.738	3.060	0.610	0.752	0.622	-2.225	3.668	0.802	-0.034 (-0.75)	0.062 (0.08)
VERIMF	343	0.655	0.600	-1.094	3.662	0.689	0.644	0.525	-1.716	4.110	0.864	0.012 (0.24)	0.075 (0.83)
VEOHLC	199	0.648	0.659	-1.775	3.856	0.989	0.591	0.581	-4.053	4.524	1.095	0.057 (0.66)	0.078 (0.02)
VEOHLF	200	0.456	0.474	-2.155	3.725	0.991	0.530	0.434	-3.299	5.088	1.296	-0.074 (-0.77)	0.040 (-0.98)
<i>Mixed</i>													
VERIMC	78	0.708	0.655	-0.573	2.469	0.663	0.666	0.567	-0.947	2.568	0.656	0.042 (0.51)	0.088 (0.46)
VERIMF	75	0.671	0.657	-1.092	2.528	0.781	0.389	0.299	-1.566	2.682	0.800	0.281 (2.78)***	0.358 (2.71)***
VEOHLC	38	0.256	0.397	-1.777	2.322	0.916	0.428	0.456	-1.088	2.749	0.834	-0.172 (-0.87)	-0.060 (-0.66)
VEOHLF	39	-0.133	0.101	-2.961	2.429	1.375	-0.114	-0.258	-2.157	2.612	0.929	-0.019 (-0.07)	0.359 (0.36)

VERIMC and VERIMF refer to the acquirer valuation errors estimated using the residual income model with a constant discount rate of 13% and a firm-specific discount rate, respectively. VEOHLC and VEOHLF refer to the acquirer valuation errors estimated using the Ohlson (2005) model with a constant discount rate of 13% and a firm-specific discount rate, respectively. Valuation error is the log of the ratio of the acquirer's closing price on the day before the acquisition announcement to the intrinsic value of the acquirer's shares estimated using a particular valuation model. All acquirer valuation errors are winsorized at the 1st and 99th percentiles. The results of *t*-tests for the difference in means and non-parametric Wilcoxon signed-rank tests for the difference in medians are reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively.

than that about acquirers; namely, acquirers are followed by a greater number of analysts (on average, 13.71 analysts followed acquirers and only 6.91 analysts followed targets), are associated with lower analyst forecast errors (the mean analyst forecast error about acquirers was 1% compared to that about targets of 2%), and are associated with lower standard deviations of analyst forecasts (the median standard deviation of analyst forecasts about acquirers was 2% compared to that about targets of 3%). These differences in the extent of information asymmetry between acquirers and targets are consistent with the differences in the firm size between the two groups (larger firms are expected to be associated with a lower degree of information asymmetry). The mean (median) market value of equity of targets is \$1.03 (0.13) billion compared to that of acquirers of \$9.56 (1.31) billion. The median relative size, measured as the ratio of the market value of target's equity to the market value of acquirer's equity, is 0.13, indicating that acquirers are almost 8 times larger than their respective targets. Acquirers have also higher market-to-book ratios compared to targets. Also, 7% of acquisitions experience competition, and acquirers offer to targets, on average, a 46% initial premium over the market value of target's shares. Finally, on average, acquirers realize a negative 1% abnormal return on their equity upon the acquisition announcement.

Panel B of Table 2 presents the summary statistics for cash and stock acquisitions and the tests of differences in means and medians between the two groups. The valuation errors of acquirers in cash acquisitions are significantly lower than those of acquirers in stock acquisitions; these differences will be tested in a more rigorous fashion in Table 3.

On the target side, Panel B of Table 2 allows us to compare the means and medians of our proxies for information asymmetry and test our hypotheses. If acquirer's choice of the medium of exchange is driven primarily by its difficulty in evaluating a target, we expect information asymmetry to be higher for stock targets than for cash targets (H2A). In particular, we expect STDFOR and FORERR to be higher, while REL and NUMA to be lower for stock targets than for cash targets. If, however, considerations related to the acquirer signaling a high private valuation to other potential bidders dominate, we expect the opposite relationship (H2B). We find that REL and NUMA are significantly lower, while STDFOR and FORERR are significantly higher, for cash targets than for stock targets.²⁵ These results imply a higher degree of information asymmetry in the equity market about cash targets and lend support to the hypothesis that acquirers' choice of cash as the medium of exchange is driven primarily by the consideration of signaling a high private valuation of the target (H2B).

Further, Panel B of Table 2 indicates that acquirers in cash acquisitions are associated with a greater extent of information asymmetry in the equity market compared to those in stock acquisitions; in particular, acquirers in cash acquisitions have significantly larger analyst forecast errors and standard deviations of analyst forecasts than acquirers in stock acquisitions.

Next, cash acquires have significantly larger cash holdings and they acquire relatively smaller firms compared to stock acquirers. The median relative size (RSIZE) in cash acquisitions is 0.07, whereas it is 0.18 in stock acquisitions. Targets in cash acquisitions have significantly smaller firm sizes and lower market-to-book ratios compared to targets in stock acquisitions. However, we do not find significant differences in firm size between cash and stock acquirers.

²⁵ To control for a possible size bias we also used coefficient of variation instead of the standard deviation of analyst forecasts. Our results remain essentially unchanged.

Panel B of Table 2 also shows that cash acquirers offer to their respective targets significantly higher initial premia (around 10 percentage points higher) than do stock acquirers and that cash acquisitions experience more competition (12% of cash transactions) compared to stock acquisitions (3% of stock transactions). We will show later in our multivariate analysis (Section 4.4) that, controlling for various other variables affecting the choice of medium of exchange, the latter result is reversed. Finally, cash acquirers realize slightly positive abnormal returns upon the acquisition announcement, which are significantly greater in magnitude than the negative abnormal returns realized by stock acquirers.

4.1.2. Univariate tests on the acquirer side

On the acquirer side, we compare means and medians of acquirer valuation errors to those of matched firms. We expect valuation errors of stock acquirers to be positive and significantly larger than those of matched firms, while for cash acquirers we expect valuation errors to be negative and significantly smaller than those of matched firms. Table 3 reports our results.²⁶

We find that stock acquirers have significantly higher valuation errors than do matched firms. Our results show that stock acquirers are, on average, overvalued by around 23 to 31% relative to a sample of industry-and-size-matched firms (according to the residual income model). The median differences in valuation errors range from 22 to 35% (according to both models). This overvaluation is statistically significant at the 1% level for the residual income model and at the 10% level for the Ohlson (2005) model (median tests only). The evidence on cash acquirers indicates that cash acquirers are, on average, correctly valued since the differences in valuation errors between acquirers and matched firms are not statistically significant.²⁷

We further investigate these results by splitting the sample into two sub-periods: 1978–1996 and 1997–2004. We choose to split the sample in this manner since Moeller et al. (2005) find that acquisitions during the merger wave of the late 1990s were significantly different from those in previous years. The results for stock-financed acquisitions (reported in Table 4) hold for both sub-periods. In particular, we find that acquirers that chose stock as the medium of exchange were overvalued both in 1978–1996 and 1997–2004 sub-periods. We also find that cash acquirers were correctly valued in both sub-periods as none of the differences in means and medians between acquirers and matched firms are statistically significant in either sub-period. The results of our univariate tests in Tables 3 and 4 indicate that acquirers that chose cash as the medium of exchange were, on average, correctly valued, whereas those that chose stock were, on average, overvalued. These findings provide support for hypothesis H1.²⁸

4.2. The choice between cash and stock

Next, we run the following logit regression to test how acquirer valuation errors and the information asymmetry faced by acquirers in evaluating targets affect the medium of exchange:

$$\log \left[\frac{P(y=1)}{1-P(y=1)} \right]_i = \beta_0 + \beta_1 VE_i + \beta_2 CD_i + \beta_3 LNRSIZE_i + \beta_4 REL_i + \beta_5 AFORERR_i + \beta_6 LNSIZE_i + \beta_7 MB_i + \beta_8 AMB_i + \varepsilon_i, \quad (6)$$

where the dependent variable takes on a value of one if the acquirer used cash and zero if it used stock as the medium of exchange, VE is the acquirer valuation error, and REL is the proxy for the extent of information asymmetry about the target. We control for the availability of cash to the acquirer by including CD, which is the ratio of the acquirer's cash holdings at the end of the fiscal year preceding the acquisition announcement to the amount paid for the target. We also control for acquirer and target firm characteristics such as LNRSIZE, which is the log of the ratio of the market value of target's equity to the market value of acquirer's equity; LNSIZE, which is the log of the target's market value of equity at the end of the fiscal year preceding the acquisition announcement; and MB and AMB, which are the target's and the acquirer's market-to-book ratios at the end of the fiscal year preceding the acquisition announcement, respectively.^{29,30} We also run the above regression with the other three proxies for the target-side asymmetric information (i.e., we replace REL in Eq. (6) by STDFOR, NUMA, and FORERR).

Finally, given that the acquisition will be consummated only if the target accepts the acquirer's bid, and that the target's willingness to accept the bid in the case of an equity offer depends upon the extent of information asymmetry it faces when

²⁶ In Tables 3 and 4 (as well as in subsequent tests) we winsorize acquirer valuation errors at the 1st and 99th percentiles to eliminate outliers that can potentially bias our results. We also conducted our tests without winsorization and with winsorization at the 5th and 95th percentiles. In the former case the significance of mean tests was slightly lower without qualitatively affecting our results, and in the latter case the results were similar to those reported here. Due to space limitations we do not report these alternative results.

²⁷ In unreported results we also separated firms in each of the medium of exchange group into mergers and tender offers. The results were not qualitatively different from those reported here; namely, cash acquirers were correctly valued while stock acquirers were overvalued.

²⁸ The evidence of Franks et al. (1988), Franks et al. (1991), and Loughran and Vijh (1997) documenting poor long-term stock performance of acquirers in stock acquisitions is consistent with our results. This is because, to the extent that poor performance is not anticipated by the market (and therefore not reflected in the current share price), such poor long-term stock performance is consistent with the overvaluation of stock acquirers. See, however, Rau and Vermaelen (1998), who provide evidence that the underperformance of stock acquirers is concentrated among glamour bidders.

²⁹ Due to collinearity, we cannot include relative size, target firm size, and acquirer firm size together in the same regression. We choose to omit acquirer firm size in the above regression specification. Omitting relative size or target firm size in such regression instead of acquirer firm size yields similar results without affecting the magnitude and the statistical significance of other independent variables.

³⁰ Carleton et al. (1983) argue that target's market-to-book ratio would be positively correlated with the potential capital gains tax liability of target firm shareholders. One would expect cash takeovers to be used more frequently when the market-to-book ratio of the target is low.

Table 4
Univariate tests of the acquirer-side asymmetric information hypothesis by sub-periods.

	1978–1996							1997–2004						
	Acquirer valuation errors			Matched firm valuation errors		Difference in means	Difference in medians	Acquirer valuation errors			Matched firm valuation errors		Difference in means	Difference in medians
	N	mean	median	mean	median			N	mean	median	mean	median		
Stock														
VERIMC	199	0.983	0.855	0.732	0.514	0.250 (4.03)***	0.341 (4.34)***	174	1.341	1.330	1.141	1.104	0.200 (2.94)***	0.226 (3.16)***
VERIMF	198	0.989	0.871	0.672	0.477	0.317 (4.44)***	0.394 (4.64)***	172	1.274	1.308	0.969	0.979	0.305 (3.91)***	0.329 (3.88)***
VEOHLC	104	0.593	0.503	0.375	0.331	0.218 (1.82)*	0.172 (1.57)	84	0.923	1.031	0.890	0.809	0.033 (0.21)	0.222 (0.94)
VEOHLF	105	0.584	0.641	0.357	0.207	0.227 (1.58)	0.434 (1.56)	81	0.794	0.975	0.771	0.633	0.023 (0.13)	0.342 (0.86)
Cash														
VERIMC	215	0.529	0.525	0.612	0.496	-0.083 (-1.49)	0.030 (-0.65)	125	1.045	1.045	0.993	0.888	0.051 (0.68)	0.157 (0.98)
VERIMF	218	0.550	0.507	0.558	0.441	-0.009 (-0.15)	0.066 (0.43)	125	0.840	0.864	0.792	0.645	0.048 (0.56)	0.219 (0.80)
VEOHLC	124	0.388	0.374	0.372	0.404	0.016 (0.15)	-0.030 (-0.02)	75	1.077	0.982	0.952	0.998	0.125 (0.89)	-0.016 (0.14)
VEOHLF	126	0.364	0.446	0.419	0.413	-0.0550 (-0.46)	0.034 (-0.47)	74	0.611	0.625	0.718	0.453	-0.107 (-0.65)	0.172 (-0.87)
Mixed														
VERIMC	39	0.629	0.604	0.578	0.444	0.051 (0.47)	0.159 (0.64)	39	0.787	0.817	0.754	0.713	0.034 (0.27)	0.104 (0.15)
VERIMF	39	0.675	0.519	0.380	0.327	0.295 (2.14)**	0.193 (2.19)**	36	0.666	0.783	0.400	0.220	0.266 (1.76)*	0.564 (1.73)*
VEOHLC	18	0.499	0.500	0.311	0.231	0.189 (0.58)	0.269 (1.59)	20	0.037	0.304	0.533	0.586	-0.496 (-2.28)**	-0.282 (-2.02)**
VEOHLF	20	0.449	0.346	-0.080	-0.113	0.528 (1.59)	0.459 (2.28)**	19	-0.745	-0.624	-0.151	-0.345	-0.594 (-1.64)	-0.279 (1.57)

VERIMC and VERIMF refer to the acquirer valuation errors estimated using the residual income model with a constant discount rate of 13% and a firm-specific discount rate, respectively. VEOHLC and VEOHLF refer to the acquirer valuation errors estimated using the Ohlson (2005) model with a constant discount rate of 13% and a firm-specific discount rate, respectively. Valuation error is the log of the ratio of the acquirer's closing price on the day before the acquisition announcement to the intrinsic value of the acquirer's shares estimated using a particular valuation model. All acquirer valuation errors are winsorized at the 1st and 99th percentiles. The results of t-tests for the difference in means and non-parametric Wilcoxon signed-rank tests for the difference in medians are reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively.

evaluating the acquirer's stock (even after observing the acquirer's choice of the medium of exchange), we also control for the extent of this information asymmetry in Eq. (6) by including AFORERR. We also run the above regression with the other two proxies for the acquirer-side asymmetric information (i.e., we replace AFORERR in Eq. (6) by ASTDFOR and ANUMA).

The expected signs of the coefficients are as follows. We expect the coefficient of VE to be negative and significantly different from zero: the higher the valuation error, the higher the likelihood of a stock offer (H1). If H2A is true, the coefficients of REL and NUMA are expected to be positive, while those of STDFOR and FORERR are expected to be negative, reflecting the hypothesized positive relationship between the level of target-side asymmetric information and the likelihood of a stock offer. If, however, H2B is true, the above signs would be reversed. Further, the greater the extent of asymmetric information facing a target when evaluating an acquirer, the less likely it is to accept a stock offer from that acquirer, and therefore the greater the probability of that acquirer making a cash offer instead. In other words, the higher the extent of asymmetric information about the acquirer, the greater the probability of a cash offer. Therefore, we expect the coefficients of ASTDFOR and AFORERR to be positive, and that of ANUMA to be negative.

Panel A of Table 5 reports the results of these logit regressions. We find that valuation errors are negatively related to the probability of choosing cash as the medium of exchange which provides support for hypothesis H1. That is, the higher the extent of acquirer overvaluation based on insiders' private information, the higher the probability of choosing stock as the medium of exchange. The results are largely consistent across different valuation models. All VE coefficients, where valuation errors were calculated using the residual income model, are significant at the 1% level. Our results are also economically significant. For an average firm, a one standard deviation increase in the VE leads to a decline of between 6.6 and 18.5% (depending on the valuation model) in the probability of choosing cash as the medium of exchange.

Our results also indicate that the larger the target relative to the acquirer, the lower the probability of cash being used as the medium of exchange; thus larger targets are more likely to be acquired by stock.³¹ Further, we find that the larger the target market-to-book ratio, the lower the probability of cash being used as a medium of exchange. This provides some support for the argument made by Carleton et al. (1983) that low market-to-book targets are expected to be taken over more frequently with cash since target's market-to-book ratio would be positively correlated with the potential capital gains tax liability of target firm shareholders.

On the target side, we find that the coefficients of REL are negative and those of STDFOR are positive and significant, indicating that the higher the level of information asymmetry about the target, the higher the likelihood of cash being used in acquisitions. These results lend support to the hypothesis that acquirer's choice of cash as the medium of exchange is driven primarily by the consideration of signaling a high private valuation of the target (H2B). These coefficients are also economically significant: for an average firm, a one standard deviation increase in STDFOR leads to an increase of between 6.4 and 9.4% in the likelihood of choosing cash as the medium of exchange. Similarly, a one standard deviation increase in REL leads to a decline of between 4.7 and 5.7% in the probability of using cash as the medium of exchange.

We also find that the level of acquirer-side information asymmetry positively affects the likelihood of a cash offer; AFORERR and ASTDFOR have positive and significant coefficients. These results are also economically significant. A one standard deviation increase in AFORERR increases the likelihood of a cash offer by between 5.1 and 21.6%, while a one standard deviation increase in ASTDFOR increases such likelihood by between 7.6 and 11.2%.

We test the robustness of our results by running logit regressions as in Eq. (6) with a continuous dependent variable which represents the proportion of cash in the total consideration offered by the acquirer for the target (in other words, in addition to cash and stock acquisitions, we also add acquisitions where the medium of exchange is a combination of cash and stock).³² The results of these regressions are reported in Panel B of Table 5. These results are very similar to those reported in Panel A of Table 5; the statistical significance of the valuation errors is slightly stronger whereas that of the target-side information asymmetry variables is slightly weaker.

We further test the robustness of our results by running an ordered logit regression:

$$\log \left[\frac{P(y=1) + P(y=2)}{1 - P(y=1) - P(y=2)} \right]_i = \beta_0 + \beta_1 VE_i + \beta_2 CD_i + \beta_3 LNRSIZE_i + \beta_4 REL_i + \beta_5 AFORERR_i + \beta_6 LNSIZE_i + \beta_7 MB_i + \beta_8 AMB_i + \varepsilon_i, \quad (7)$$

where the dependent variable takes on the following values: zero for stock acquisitions, one for mixed acquisitions, and two for cash acquisitions. We expect the coefficients of VE to be negative and significantly different from zero, reflecting the expectation that the probability of choosing cash or a combination of cash and stock as the medium of exchange (relative to the probability of choosing stock as the medium of exchange) is decreasing with the valuation error.

We also run the above regression with the other proxies for the target-side information asymmetry (i.e., we replace REL in Eq. (7) by STDFOR, FORERR, and NUMA). If the choice of medium of exchange is driven primarily by acquirer's difficulty in evaluating a target, we expect positive coefficients for REL and NUMA and negative coefficients for STDFOR and FORERR, implying that the probabilities of cash and mixed acquisitions decrease relative to those of stock acquisitions with the level of information asymmetry faced by the

³¹ We also estimated regressions in Table 5 by eliminating acquisitions involving very small targets with a relative size of less than 1%. The results of such estimations were essentially unchanged.

³² We make use of logit regressions here since the dependent variable is a proportion bounded between 0 and 1: see, e.g., Hox (2002).

Table 5
Logit regressions regarding the choice of the medium of exchange.

Panel A. Logit regressions, where dependent variable is equal to one if the medium of exchange was cash, and zero if it was stock.								
Valuation model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	RIMC	RIMC	RIMF	RIMF	OHLC	OHLC	OHLF	OHLF
Constant	0.343 (0.79)	-0.302 (-0.55)	0.175 (0.41)	0.081 (0.13)	0.465 (0.62)	0.420 (0.76)	-0.375 (-0.54)	-0.205 (-0.29)
VE	-0.997 (-6.62)***	-1.074 (-6.17)***	-0.799 (-6.00)***	-0.830 (-5.10)***	-0.008 (-0.06)	0.063 (0.51)	-0.245 (-1.85)*	-0.235 (-1.76)*
CD	0.137 (1.08)	0.100 (1.05)	0.132 (1.02)	0.073 (0.80)	0.036 (0.40)	0.094 (0.93)	0.046 (0.63)	0.045 (0.61)
LNRSIZE	-0.290 (-3.64)***	-0.364 (-4.26)***	-0.298 (-3.76)***	-0.405 (-3.34)***	-0.416 (-3.50)***	-0.287 (-2.95)***	-0.460 (-4.14)***	-0.426 (-3.82)***
REL	-0.418 (-2.27)**		-0.385 (-2.11)**			-0.458 (-2.02)**		
NUMA		-0.015 (-0.67)						
FORERR							10.200 (1.53)	10.335 (1.46)
STDFOR				3.968 (2.57)**	2.660 (1.74)*			
ANUMA				0.004 (0.25)				
AFORERR	11.429 (1.98)**	11.219 (1.99)**	12.101 (1.90)*				57.129 (2.00)**	
ASTDFOR					6.072 (2.03)**	3.793 (2.28)**		5.705 (2.38)**
LNSIZE	-0.009 (-0.14)	0.088 (0.81)	-0.016 (-0.24)	-0.120 (-1.07)	-0.211 (-1.79)*	-0.077 (-0.91)	-0.055 (-0.54)	-0.090 (-0.83)
MB	-0.106 (-1.86)*	-0.151 (-1.92)*	-0.107 (-1.88)*	-0.106 (-1.22)	-0.264 (-2.77)***	-0.171 (-2.87)***	-0.238 (-2.85)***	-0.257 (-2.97)***
AMB	0.014 (3.00)***	0.015 (2.97)***	0.007 (1.51)	0.009 (1.71)*	-0.056 (-0.87)	-0.113 (-2.04)**	-0.049 (-0.79)	-0.024 (-0.40)
Pseudo R ²	0.1564	0.1604	0.1495	0.1734	0.1764	0.1355	0.1754	0.1763
N	621	517	622	459	285	391	311	308

acquirer when evaluating the target. Conversely, if considerations related to the acquirer signaling a high private valuation to other potential bidders dominate, we expect the signs of the above coefficients to be reversed.

Table 6 reports the results of our ordered logit regressions. We find the coefficients of VE to be negative, implying that the probability of a cash or a mixed acquisition (relative to the probability of a stock acquisition) is decreasing with VE, which provides support for hypothesis H1. These results are both statistically and economically significant. In particular, for an average firm, a one standard deviation increase in valuation error leads to a decline of between 6.5 and 16.4% in the probability of a cash acquisition, a decline of between 0.1 and 1.3% in the probability of a mixed cash and stock acquisition, and an increase of between 6.6 and 17.7% in the probability of a stock acquisition (depending on the valuation model).

On the target side, we find that the probability of a cash or a mixed acquisition (relative to the probability of a stock acquisition) is increasing with STDFOR and FORERR and decreasing with REL. In particular, for an average firm, a one standard deviation increase in REL leads to a decline of between 3.7 and 5.3% in the likelihood of a cash acquisition, a decline of about 0.1% in the likelihood of a mixed acquisition, and an increase of between 3.8 and 5.4% in the likelihood of a stock acquisition. Similarly, a one standard deviation increase in FORERR leads to a 34.5% increase in the probability of a cash acquisition and a 34.5% decline in the probability of a stock acquisition. Our results imply that the considerations related to the acquirer signaling a high private valuation to other potential bidders dominate the considerations related to the acquirer having difficulty in evaluating a target and provide support for hypothesis H2B.

We also find that the proxies of acquirer-side asymmetric information have a significant effect on the choice of a medium of exchange. Our results show that the probability of a cash or a mixed acquisition (relative to that of a stock acquisition) is increasing with AFORERR and ASTDEV, implying that the higher the level of information asymmetry faced by the target when evaluating the acquirer's offer, the higher the likelihood of a cash offer. In particular, a one standard deviation increase in AFORERR increases the probability of a cash acquisition by between 4.3 and 5.0%, increases the probability of a mixed acquisition by between 0.2 and 0.4%, and decreases the probability of a stock acquisition by between 4.4 and 5.4%.

4.3. Announcement effects and acquirer under- or overvaluation

We now study how the extent of acquirer under- or overvaluation affects the abnormal returns to the acquirer's equity upon the acquisition announcement. We estimate market model parameters over 250 trading days ending on the 46th day prior to the

Table 5 (continued)

Panel B. Logit regressions, where dependent variable is the fraction of cash used as a medium of exchange.								
Valuation model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	RIMC	RIMC	RIMF	RIMF	OHLC	OHLC	OHLF	OHLF
Constant	0.489 (1.23)	−0.230 (−0.46)	0.304 (0.76)	0.054 (0.09)	0.179 (0.27)	0.605 (1.19)	−0.038 (−0.06)	−0.065 (−0.10)
VE	−0.959 (−6.87)***	−1.024 (−6.35)***	−0.763 (−6.22)***	−0.726 (−5.03)***	−0.140 (−1.00)	−0.061 (−0.52)	−0.311 (−2.51)**	−0.284 (−2.28)**
CD	0.142 (1.13)	0.107 (1.09)	0.136 (1.06)	0.081 (0.84)	0.040 (0.42)	0.094 (0.93)	0.050 (0.69)	0.046 (0.64)
LNRSIZE	−0.208 (−2.88)***	−0.270 (−3.55)***	−0.222 (−3.07)***	−0.285 (−2.60)***	−0.317 (−2.96)***	−0.186 (−2.07)**	−0.341 (−3.48)***	−0.332 (−3.35)***
REL	−0.269 (−1.56)		−0.248 (−1.44)			−0.298 (−1.39)		
NUMA		−0.021 (−1.02)						
FORERR							8.058 (1.35)	8.173 (1.25)
STDFOR				3.323 (2.76)***	2.106 (1.52)			
ANUMA				0.008 (0.52)				
AFORERR	11.820 (2.13)**	12.693 (2.21)**	12.587 (1.99)**				42.539 (1.82)*	
ASTDFOR					5.842 (1.90)*	3.671 (2.26)**		5.175 (2.27)**
LNSIZE	0.029 (0.48)	0.160 (1.57)	0.022 (0.35)	−0.040 (−0.39)	−0.100 (−0.99)	−0.059 (−0.76)	−0.038 (−0.41)	−0.054 (−0.55)
MB	−0.116 (−2.23)**	−0.160 (−2.31)**	−0.116 (−2.20)**	−0.125 (−1.64)	−0.239 (−2.54)**	−0.170 (−2.87)***	−0.210 (−2.47)**	−0.219 (−2.53)**
AMB	0.016 (2.18)**	0.019 (1.34)	0.009 (1.24)	0.016 (0.73)	−0.007 (−0.14)	−0.058 (−1.22)	−0.017 (−0.33)	0.002 (0.03)
Pseudo R ²	0.1265	0.1330	0.1204	0.1335	0.1312	0.0981	0.1331	0.1345
N	682	569	682	500	306	425	339	334

VE is the valuation error measured as the log of the ratio of the acquirer's closing price on the day before the acquisition announcement to the intrinsic value of the acquirer's shares estimated using the valuation model specified at the top of the column. RIMC and RIMF refer to the residual income model with a constant discount rate of 13% and a firm-specific discount rate, respectively. OHLC and OHLF refer to the Ohlson (2005) model with a constant discount rate of 13% and a firm-specific discount rate, respectively. CD is the ratio of the acquirer's holdings of cash and marketable securities at the end of the fiscal year preceding the acquisition announcement to the amount paid for the target. LNRSIZE is the log of the ratio of the market value of target's equity to the market value of acquirer's equity. REL is equal to one if the acquirer and the target have the same 3-digit SIC code, and zero otherwise. FORERR and AFORERR are the target's and the acquirer's analyst forecast errors defined as the ratio of the absolute value of the difference between the analyst forecast and the realized value of earnings to the stock price, respectively. STDFOR and ASTDFOR are the target's and the acquirer's standard deviations of analyst forecasts for the last month of the fiscal year prior to the acquisition announcement, respectively, while NUMA and ANUMA are the numbers of analysts following the target and the acquirer in the same month, respectively. LNSIZE is the log of the target's market value of equity at the end of the fiscal year prior to the acquisition announcement. MB and AMB are the target's and the acquirer's market-to-book ratios at the end of the fiscal year prior to the acquisition announcement, respectively. All valuation errors are winsorized at the 1st and 99th percentiles. *t*-statistics are given in parentheses. White heteroskedasticity adjusted errors are used in calculating *t*-statistics. ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively.

acquisition announcement. Abnormal returns are calculated over different event windows ranging from a day before to five days after the announcement. If the choice of the medium of exchange reveals part of managers' private information, we expect to find a significant relationship between valuation errors and the magnitude of the announcement effects. In particular, we expect this relationship to be negative. The regression employed is as follows:

$$ANEF_i = \beta_0 + \beta_1 VE_i + \beta_2 LNASIZE_i + \epsilon_i, \tag{8}$$

where ANEF is the cumulative abnormal return to acquirer's equity upon the acquisition announcement and LNASIZE is the log of the acquirer's market value of equity at the end of the fiscal year preceding the acquisition announcement. We use LNASIZE to control for firm size.

Table 7 reports the results of the regressions with announcement effects as dependent variables. The coefficients of valuation errors are negative and highly significant in most of the specifications. This implies that, as expected, more overvalued acquirers have lower announcement effects. The influence of valuation errors on announcement effects is also economically significant. A one standard deviation increase in the valuation error leads to a reduction of between 0.6 and 1.4 percentage points in the abnormal returns. These reductions represent between 97% (169) and 151% (169) of an average (median) firm's abnormal returns. These results support the implications of the asymmetric information models discussed above, which predict that acquisitions financed by stock will have a lower announcement effect.

Table 6
Ordered logit regressions regarding the choice of the medium of exchange.

Valuation model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	RIMC	RIMC	RIMF	RIMF	OHLC	OHLC	OHLF	OHLF
VE	−0.925 (−7.10)***	−1.002 (−6.64)***	−0.737 (−6.49)***	−0.767 (−5.55)***	−0.119 (−0.88)	−0.005 (−0.04)	−0.240 (−2.20)**	−0.231 (−2.07)**
CD	0.151 (1.17)	0.112 (1.18)	0.146 (1.10)	0.077 (0.90)	0.055 (0.52)	0.125 (0.92)	0.066 (0.77)	0.063 (0.75)
LNRSIZE	−0.266 (−3.70)***	−0.327 (−4.45)***	−0.277 (−3.84)***	−0.332 (−3.34)***	−0.348 (−3.26)***	−0.226 (−2.38)**	−0.383 (−4.00)***	−0.367 (−3.70)***
REL	−0.326 (−1.94)*		−0.307 (−1.84)*			−0.428 (−2.02)**		
NUMA		−0.015 (−0.76)						
FORERR							11.874 (1.76)*	11.308 (1.63)
STDFOR				2.478 (2.62)***	2.800 (2.12)**			
ANUMA				0.007 (0.49)				
AFORERR	9.389 (2.60)***	10.632 (2.78)***	9.900 (2.54)**				27.472 (1.51)	
ASTDFOR					0.265 (1.15)	0.290 (1.03)		4.886 (2.49)**
LNSIZE	0.019 (0.34)	0.130 (1.38)	0.010 (0.18)	−0.067 (−0.70)	−0.090 (−0.96)	−0.048 (−0.66)	−0.005 (−0.05)	−0.038 (−0.41)
MB	−0.109 (−2.15)**	−0.154 (−2.30)**	−0.108 (−2.11)**	−0.118 (−1.62)	−0.218 (−2.50)**	−0.155 (−2.75)***	−0.204 (−2.54)**	−0.212 (−2.58)***
AMB	0.013 (2.89)***	0.015 (3.00)***	0.007 (1.51)	0.010 (1.66)*	−0.053 (−1.04)	−0.104 (−2.19)**	−0.041 (−0.87)	−0.017 (−0.37)
Pseudo R ²	0.1089	0.1125	0.1041	0.1150	0.1066	0.0865	0.1162	0.1199
N	682	569	682	500	306	425	339	334

The dependent variable takes on a value of zero if the medium of exchange was stock, one if the medium of exchange was mixed cash and stock, and two if the medium of exchange was cash. VE is the valuation error measured as the log of the ratio of the acquirer's closing price on the day before the acquisition announcement to the intrinsic value of the acquirer's shares estimated using the valuation model specified at the top of the column. RIMC and RIMF refer to the residual income model with a constant discount rate of 13% and a firm-specific discount rate, respectively. OHLC and OHLF refer to the Ohlson (2005) model with a constant discount rate of 13% and a firm-specific discount rate, respectively. CD is the ratio of the acquirer's holdings of cash and marketable securities at the end of the fiscal year preceding the acquisition announcement to the amount paid for the target. LNRSIZE is the log of the ratio of the market value of target's equity to the market value of acquirer's equity. REL is equal to one if the acquirer and the target have the same 3-digit SIC code, and zero otherwise. FORERR and AFORERR are the target's and the acquirer's analyst forecast errors defined as the ratio of the absolute value of the difference between the analyst forecast and the realized value of earnings to the stock price, respectively. STDFOR and ASTDFOR are the target's and the acquirer's standard deviations of analyst forecasts for the last month of the fiscal year prior to the acquisition announcement, respectively, while NUMA and ANUMA are the numbers of analysts following the target and the acquirer in the same month, respectively. LNSIZE is the log of the target's market value of equity at the end of the fiscal year prior to the acquisition announcement. MB and AMB are the target's and the acquirer's market-to-book ratios at the end of the fiscal year prior to the acquisition announcement, respectively. All valuation errors are winsorized at the 1st and 99th percentiles. *t*-statistics are given in parentheses. White heteroskedasticity adjusted errors are used in calculating *t*-statistics. ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively.

Our findings in Tables 5–7 are also consistent with an alternative signaling explanation. As discussed above, cash offers are costly signals of high valuation of targets by acquirers. This high valuation can be due to an expected higher future profitability, which leads to higher estimates of intrinsic value relative to the pre-acquisition (pre-signaling) market value. This results in lower valuation errors, which, as we demonstrated, increase the likelihood of cash offers.³³

4.4. Medium of exchange, competition, and double-sided asymmetric information

So far, we have found significant empirical support for the hypothesis that acquirers signal a high private valuation of targets to other potential bidders by using cash as a medium of exchange. Since an important implication of this hypothesis is that the use of cash as the medium of exchange deters competing bidders, in this section we study this implication in more detail.

In the setting of Fishman (1988, 1989), in addition to cash, the acquirer can use the bid premium to deter competition. The choice of the medium of exchange and the bid premium are thus determined simultaneously in that setting. Therefore, in this section we study the firm's choice of the medium of exchange using the following simultaneous equation framework, incorporating both the bid premium and the presence or absence of competing bidders:

$$\text{COMPETE}_i = \beta_0 + \beta_1 \text{CASH}_i + \beta_2 \text{BPREM}_i + \beta_3 \text{STDFOR}_i + \varepsilon_i; \quad (9a)$$

³³ We thank an anonymous referee for pointing out this alternative explanation.

Table 7
Relationship between acquirer under- or overvaluation and the abnormal returns to acquirer's equity upon the acquisition announcement.

Dependent variable event windows	(1) [0; +5]	(2) [0; +5]	(3) [0; +5]	(4) [0; +5]	(5) [0]	(6) [0]	(7) [0]	(8) [0]	(9) [-1; +1]	(10) [-1; +1]	(11) [-1; +1]	(12) [-1; +1]
Valuation model	RIMC	RIMF	OHLC	OHLF	RIMC	RIMF	OHLC	OHLF	RIMC	RIMF	OHLC	OHLF
Constant	0.027 (2.29)**	0.027 (2.21)**	0.007 (0.52)	0.010 (0.68)	0.023 (3.17)***	0.025 (3.21)***	0.020 (2.07)**	0.023 (2.42)**	0.031 (3.00)***	0.032 (2.89)***	0.021 (1.70)*	0.021 (1.71)*
VE	-0.016 (-3.22)***	-0.014 (-3.19)***	-0.007 (-1.94)*	-0.005 (-1.53)	-0.008 (-3.04)***	-0.010 (-3.76)***	-0.005 (-2.04)**	-0.004 (-2.09)**	-0.011 (-2.65)***	-0.011 (-2.77)***	-0.005 (-1.62)	-0.003 (-1.02)
ALNSIZE	-0.003 (-1.97)**	-0.003 (-2.04)**	-0.001 (-0.71)	-0.002 (-1.06)	-0.003 (-3.27)***	-0.003 (-3.24)***	-0.003 (-2.48)**	-0.003 (-2.96)***	-0.004 (-2.82)***	-0.004 (-2.86)***	-0.003 (-1.93)*	-0.003 (-2.18)**
R ²	0.0295	0.0319	0.0138	0.0111	0.0328	0.0442	0.0340	0.0386	0.0294	0.0332	0.0201	0.0152
N	800	800	493	498	798	798	491	496	800	800	493	498

The dependent variable is the abnormal return to the acquirer's equity upon the acquisition announcement cumulated over different event windows. The acquisition announcement date is denoted as date 0. Market model parameters are calculated over 250 trading days ending on the 46th trading day before the acquisition announcement. VE is the valuation error estimated using the valuation model specified at the top of the column. RIMC and RIMF refer to the residual income model with a constant discount rate of 13% and a firm-specific discount rate, respectively. OHLC and OHLF refer to the Ohlson (2005) model with a constant discount rate of 13% and a firm-specific discount rate, respectively. Valuation error is the log of the ratio of the acquirer's closing price on the day before the acquisition announcement to the intrinsic value of the acquirer's shares estimated using a particular valuation model. ALNSIZE is the log of the acquirer's market value of equity at the end of the fiscal year preceding the acquisition announcement. Valuation errors are winsorized at the 1st and 99th percentiles. *t*-statistics are given in parentheses. White heteroskedasticity adjusted errors are used in calculating *t*-statistics. ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively.

Table 8
Effect of the choice of the medium of exchange on the likelihood of competition.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	COMPETE	BPREM	CASH	COMPETE	BPREM	CASH
Intercept	4.741 (1.59)	26.870 (6.14)***	-2.875 (-0.21)	-0.959 (-0.63)	22.899 (0.53)	-3.530 (-1.79)*
CASH	-3.586 (-1.85)*	21.202 (2.22)**		5.184 (1.51)	59.190 (1.90)*	
BPREM	-0.146 (-2.59)**		0.078 (0.24)	-0.086 (-1.48)		0.066 (2.42)**
VE		9.257 (1.35)	-1.137 (-0.57)			
STDFOR	10.990 (3.92)***	25.628 (0.93)	-1.008 (-0.08)	4.533 (3.40)***	-3.325 (-0.03)	0.488 (0.31)
Pseudo R ²	0.0919			0.0771		
N	532	532	532	532	532	532

The results presented are from a simultaneous equation estimation. The equations are defined as follows:

$$COMPETE_i = \beta_0 + \beta_1 CASH_i + \beta_2 BPREM_i + \beta_3 STDFOR_i + \varepsilon_i;$$

$$BPREM_i = \delta_0 + \delta_1 CASH_i + \delta_2 VE_i + \delta_3 STDFOR_i + \eta_i;$$

$$CASH_i = \alpha_0 + \alpha_1 BPREM_i + \alpha_2 VE_i + \alpha_3 STDFOR_i + v_i.$$

COMPETE is equal to one if there was a competing offer, and zero otherwise. BPREM is the initial bid premium, defined as the percentage by which the initial bid exceeds the target's closing share price 4 weeks before the acquisition announcement. CASH is equal to one if the initial offer was in cash, and zero otherwise. VE is the valuation error defined as the log of the ratio of the acquirer's closing price on the day before the acquisition announcement to the intrinsic value of the acquirer's shares estimated using the residual income model with a firm-specific discount rate. STDFOR is the target's standard deviation of earnings forecasts as reported by IBES for the last month of the fiscal year preceding the acquisition announcement. Valuation errors are winsorized at the 1st and 99th percentiles. *t*-statistics are given in parentheses. White heteroskedasticity adjusted errors are used in calculating *t*-statistics. ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively.

$$BPREM_i = \delta_0 + \delta_1 CASH_i + \delta_2 VE_i + \delta_3 STDFOR_i + \eta_i; \tag{9b}$$

$$CASH_i = \alpha_0 + \alpha_1 BPREM_i + \alpha_2 VE_i + \alpha_3 STDFOR_i + v_i; \tag{9c}$$

where COMPETE takes on a value of one if there was a competing offer, and zero otherwise; BPREM is the initial percentage bid premium; and CASH takes on a value of one if the initial offer was a cash offer, and zero otherwise.³⁴ Eqs. (9b) and (9c) are estimated simultaneously and the predicted values of BPREM and CASH are then used in Eq. (9a). The above framework is somewhat similar to that used by Jennings and Mazzeo (1993), who, however, use only target-side variables and find that the use of cash is associated with increased competition. Clearly, in the double-sided asymmetric information setting that we discussed in the introduction, it is important to include both the acquirer- and target-side variables in the estimation of both the acquirer's choice of the medium of exchange and the influence of cash on the likelihood of a competing offer. We therefore include the extent of acquirer overvaluation (VE), and the extent of information asymmetry about the target faced by the acquirer (STDFOR) in the above specification.³⁵

In the Fishman (1989) model, the extent of information asymmetry regarding the target influences the extent of competition in two ways. First, targets with a low level of asymmetric information are more likely to attract competing bids. In other words, the extent of asymmetric information characterizing the target determines the potential for competition. Second, the level of asymmetric information influences competition by affecting the acquirer's choice of the medium of exchange. In the presence of a higher level of information asymmetry about the target, the acquirer is more likely to use cash to pay for the acquisition, thus signaling its high valuation of the target firm, which deters potential competing bids.

The results of our estimation are reported in Table 8. We first replicate the results of Jennings and Mazzeo (1993) (columns 4, 5, and 6) and find that without the acquirer-side variables our results are consistent with their findings (i.e., there is a positive, though not statistically significant, relationship between the probability of a competing offer and the use of cash as the medium of exchange). However, when we include acquirer-side variables (columns 1, 2, and 3), our findings overturn those of Jennings and Mazzeo (1993).³⁶ We find that cash does indeed deter competition as the coefficient of CASH (regression 1) is negative and

³⁴ The bid premium (BPREM) is the percentage by which the initial bid exceeds the target's closing stock price four weeks before the acquisition announcement.

³⁵ Note that we do not include any measure of acquirer overvaluation (VE) in Eq. (9a). This acquirer-specific variable is clearly private information and not observed by other bidders, and should therefore not directly impact the bidding decisions of these bidders. It will only indirectly affect these bidding decisions through the acquirer's choice between cash and stock as well as through the bid premium offered by it.

³⁶ While the results presented here use valuation errors based on the residual income model using a firm-specific discount rate, the results are similar when valuation errors based on the other valuation models (used in earlier tests) are used in these regressions.

statistically significant. We thus find support for Fishman's (1989) prediction that cash deters competition, though the coefficients on the target-side asymmetric information variables are opposite to those predicted by his model. Overall, we find that asymmetric information on both the acquirer and target sides simultaneously determine the acquirer's choice of the medium of exchange. In particular, considering asymmetric information variables only on one side (target or acquirer) at a time may lead us to draw somewhat misleading conclusions about the role of asymmetric information in determining the medium of exchange in acquisitions.

5. Conclusion

This paper has presented the first direct empirical analysis in the literature of the choice of the medium of exchange in acquisitions in a setting where the private information held by the acquirer and the target together determine this choice. Our results can be summarized as follows. First, stock acquirers are significantly overvalued with respect to their intrinsic value computed conditional on insiders' private information, while cash acquirers are correctly valued. These results are robust to alternative valuation models used to estimate the intrinsic value of acquirers' shares. Second, our logit and ordered logit regression analyses indicate that the extent of acquirer overvaluation has a significant positive influence on the likelihood of acquirer using stock as the medium of exchange. Further, the greater the extent of information asymmetry faced by an acquirer in evaluating a target, the greater the likelihood of a cash offer. This finding is consistent with considerations of the acquirer signaling its high private valuation of the target to rival bidders dominating those of its difficulty in evaluating the target. Third, the extent of acquirer overvaluation is negatively related to the abnormal returns on the acquirer equity upon acquisition announcement (as we would expect in an asymmetric information setting). Finally, we find that the use of cash by an acquirer deters rival bids, again consistent with the notion that the use of cash may signal the acquirer's high valuation of the target to potential rivals. Ours is the first paper to demonstrate that private information on the part of acquirer and target simultaneously determines the choice between cash and stock. Most of the other empirical findings we have listed above are also new to the literature.

Acknowledgements

The authors are grateful to Jim Booth, Espen Eckbo, Micah Officer, Raghavendra Rau, Kristian Rydqvist, Susan Shu, Robert Taggart, and Hassan Tehrani as well as conference participants at the European Finance Association Meetings, the Financial Management Association Meetings, and seminar participants at Boston College, Concordia University, Dalhousie University, University of Manitoba, Norwegian School of Management (BI), and York University for helpful comments and discussions. Special thanks to an anonymous referee and Jeffry Netter (the editor) for several helpful comments and suggestions. We also thank IBES for permission to use their database.

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